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Dynamo generated magnetic configurations in accretion discs and the nature of quasi-periodic oscillations in accreting binary systems

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Abstract

© ESO 2016.Context. Magnetic fields are important for accretion disc structure. Magnetic fields in a disc system may be transported with the accreted matter. They can be associated with either the central body and/or jet, and be fossil or dynamo excited in situ. Aims. We consider dynamo excitation of magnetic fields in accretion discs of accreting binary systems in an attempt to clarify possible configurations of dynamo generated magnetic fields. We first model the entire disc with realistic radial extent and thickness using an alpha-quenching non-linearity. We then study the simultaneous effect of feedback from the Lorentz force from the dynamo-generated field. Methods. We perform numerical simulations in the framework of a relatively simple mean-field model which allows the generation of global magnetic configurations. Results. We explore a range of possibilities for the dynamo number, and find quadrupolar-type solutions with irregular temporal oscillations that might be compared to observed rapid luminosity fluctuations. The dipolar symmetry models with $R\alpha < 0$ have lobes of strong toroidal field adjacent to the rotation axis that could be relevant to jet launching phenomena. Conclusions. We have explored and extended the solutions known for thin accretion discs.

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Keywords

Accretion, accretion disks, Binaries: close, Dynamo, Magnetic fields, Stars: dwarf novae